*भारतीय मानक*
*Indian Standard*

**IS 3937 (Part 3) : 2022**

# तार की रस्सियों की सॉकेटिंग के लिए संस्तुतियाँ

## भाग 3 रेज़िन सहित सॉकेटिंग

*( पहला पुनरीक्षण )*

# Recommendations for Socketing of Wire Ropes

## Part 3 Socketing with Resins

*( First Revision )*

ICS 77.140.65



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Wire Ropes and Wire Products Sectional Committee, MED 10

FOREWORD

This Indian Standard (Part 3) (First revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Wire Ropes and Wire Products Sectional Committee had been approved by the Mechanical Engineering Division Council.

This Standard provides guidance on recommended practices for the resin socketing of wire ropes.

This standard was first published in 1994. This standard is being revised again to keep pace with the latest technological developments and international practices. In this revision, the following major changes have been made :

1) A reference clause has been added mentioning the latest version of all the referred standards.

2) Editorial corrections have been done.

This standard on Socketing with resins is one of the series of standards on Socketing. Other parts of this standard are :

IS 3937 (Part 1) : 1974 — Socketing with Zinc (First Revision)
IS 3937 (Part 2) : 1974 — Socketing with white metal (First Revision)

In the formulation of this standard, assistance has been derived from the following publications:

ISO 17558 : 2006 — Steel wire ropes — Socketing procedures — Molten metal and resin socketing.

The composition of the committee responsible for the formulation of this standard is given in Annex C.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

*Indian Standard*

# RECOMMENDATIONS FOR SOCKETING OF WIRE ROPES PART 3 SOCKETING WITH RESINS

*( First Revision )*

## 1 SCOPE

This Indian Standard (Part 3) provides guidance on recommended practices for the resin socketing of wire ropes.

## 2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. In case the standards are to be referred in this clause they are to be listed as follows:

| *IS No.* | *Title* |
|---|---|
| 13902 (Part 1) : 1993 | Sockets for wire ropes for general purposes — Part 1 General characteristics and conditions for acceptance |
| 13902 (Part 2) : 1993 | Sockets for wire ropes for general purposes — Part 2 special requirements for sockets produced by forging or machined from the solid |
| 13360 (Part 5/Sec 8) : 2013 | Plastics — Methods of testing — Part 5 mechanical properties section 8 determination of compressive properties *(first revision)* |
| 13360 (Part 6/Sec 17 ) : 2017 | Plastics — Methods of testing — Part 6 thermal properties section 17 determination of temperature of deflection under load — Plastics and ebonite *(second revision)* |
| 1448 : ( Part 32 ) : 2019 | Methods of test for petroleum and its products [p : 32] crude petroleum and liquid or solid petroleum products — Determination of density or relative density — Capillary stoppered pyknometer and graduated bicapillary pyknometer methods *(third revision)* |

## 3 GENERAL

**3.1** Type testing for performance assessment of socketing system as per Annex A.

**3.2** For each socketing system for which the socket is intended to be used, the socket system designer shall carryout tensile tests on socketed end terminations representing the most extreme and unfavourable combinations of rope construction, rope strength and socket basket dimensions

## 4 PREPARATION OF THE ROPE END

A sufficient length of the rope should be externally cleaned on both sides of the designated point of cut by wiping with a clean dry cloth. This cleaning should be confined to the length of rope to be threaded through the socket.

### 4.1 Seizing of the Rope

Two types of seizing are recognized :

a) Temporary seizing is used when cutting non-preformed ropes, multi strand ropes, spiral strands, etc. A temporary seizing may be applied to the rope on each size of the cut. This seizing should be such as to hold the strands and wires reasonably well in position during the cutting operation.

b) Permanent seizing is used to hold the wires and strands during the socketing operation. A permanent seizing is applied to that part of the rope which is partly within or adjacent to the mouth of the socket or immediately outside the socket when the operation is completed. The permanent seizing should.

   1) Ensure that the wires and strands are undisturbed during socketing operations; and

   2) Permit the passage of the seized rope through the mouth of the socket.

### 4.2 Seizing Material

The seizing material should be tinned or galvanized soft wire or strand for galvanized rope, and bright or galvanized soft wire or strand for bright rope. Alternative materials may be used but care should be taken that they do not cause deleterious electrolytic action in service. Copper and brass wires should not be used for seizing. Plastic seizing of proved suitability may be allowed.

### 4.3 Cutting the Rope

The rope should be cut by any suitable method which does not disturb the position of the wires below the permanent seizing. Cutting with an abrasive wheel is to be preferred. When cutting by percussive or shearing methods special care is required. Oxyacetylene cutting should not be employed owing to the risk of heat damage to the wires and lubrication, and to the difficulties of separating the wires during subsequent socketing operations.

## 5 PREPARATION OF THE BRUSH

### 5.1 Preparation of the Rope

**5.1.1** Before threading the socket onto the rope, all dirt, grease or scale should be removed from the inside of the basket.

**5.1.2** The cut end of the rope should be threaded through the socket taking care that the basket walls do not come into contact with the uncleaned part of the rope. If this does occur, the rope should be unthreaded and the socket walls recleaned. After threading, the temporary seizing at the point of cut should be removed and the strands unlaid as far as the permanent seizing, and swept outwards to allow the opening of the wires.

**5.1.3** The opening angle of the final brush should not exceed 45° from the vertical for stranded ropes [*see* Fig. 1 (a)].

**5.1.4** For locked coil ropes and spiral strands the wires should be unlaid and swept outwards at an angle not exceeding 60° from the vertical [*see* Fig. 1 (b)].

**5.1.5** When a rope contains a stee1 core, the wires of the core should be completely unlaid to form an open brush.

**5.1.6** When a rope contains a fibre core, the core should be cut and removed down to the permanent seizing.

**5.1.7** After dealing with *the* core *the* individual wires from the strands should be unlaid (but not straightened) and a brush formed.

**5.1.8** Care should be taken not to bend the wires or the strands to an excessive angle at the permanent seizing, since this may cause premature fatigue failure in the completed assembly.

### 5.2 Cleaning and Degreasing

**5.2.1** The open brush should be thoroughly cleaned and degreased, with either an approved organic solvent, or an emulsion type cleaner. Hot degreasing solutions are preferred. Petrol, paraffin and similar materials are not recommended.

**5.2.2** When using liquid degreasing agents, the brush should be held downward to prevent the degreasing fluid, or water, being trapped in the throat of the brush. The degreasing process may be accelerated by use of an ultrasonic device. The degreasing agent should be liberally used and worked well into the throat of the brush.

**5.2.3** If water-based cleaning agents are used, the residues should be completely removed by washing off in the water.

**5.2.4** When using a vapour degreasing method, the brush should be held inserted in the vapour until all the grease and dirt have been removed. Care must be taken to ensure that the rope above the serving is not immersed in the vapour.

**5.2.5** *Caution*

During the cleaning and degreasing operations, the following precautions shall be taken :

a) Great care must be taken that degreasing is confined to the brush, and does not affect the rope beyond the brush.

b) When using water-based cleaning agents, it is essential to ensure that the agent is completely removed, and that the brush is dried quickly.

c) In all cases the time between cleaning and pouring the socketing resin should be as short as possible to minimize oxidation and corrosion of the rope.

d) Chlorinated hydrocarbons and other toxic or flammable organic solvents shall only be used in areas designed for the purpose, or in an extremely well ventilated environment.

### 5.3 Hooking

Hooking of wires (i.e. turning over the wire ends without a sharp radius) is recommended for 6 × 7 and similar coarse construction ropes especially where there is the possibility of shock loading. Hooking of wires for other constructions is not normally necessary.

## 6 POSITIONING AND ALIGNMENT OF BRUSH, ROPE AND SOCKET

**6.1** A seizing wire shall be placed around the brush near its top end to draw the brush slightly together to form a shape approximating to, but slightly smaller than, the shape of the socket basket, to prevent an appreciable length of the outermost wires from bearing against the wall of the socket when the socket is positioned over the brush.

**6.2** The socket basket should be drawn over the brush until the ends of the wires, or the bends in the hooked wires, are 1 to 2 mm above the basket of the socket. Alternatively, the wire ends may be slightly below the top of the socket, but in these cases the rope just below the mouth of the socket should be marked to indicate any movement during subsequent operations.

**6.3** The wires should be evenly distributed as far as possible at the top of the socket basket.

**6.4** Following the positioning of the brush, the rope should be clamped to a suitable support and the axes of the rope and socket aligned. The rope below the socket should be straight for at least 30 times the rope diameter, after which the rope may be allowed to bend but with a radius of at least 50 times the rope diameter.

**6.5** The neck of the socket should then be sealed with yarn, fibre or flexible putty or clay (the latter being especially useful in the case of large open-lay ropes) to prevent the passage of resin. Care should be taken to ensure that the sealing material is not pushed into the gap between the socket and the rope. If this occurs it will prevent penetration of the resin through to the socket mouth, which could lead to corrosion and premature fatigue failure in service.

## 7 PREPARATION AND POURING OF SOCKETING RESIN

**7.1** The resin should be mixed and poured in accordance with the manufacturer's instructions. In all cases the resin should be poured close to the side of the socket.

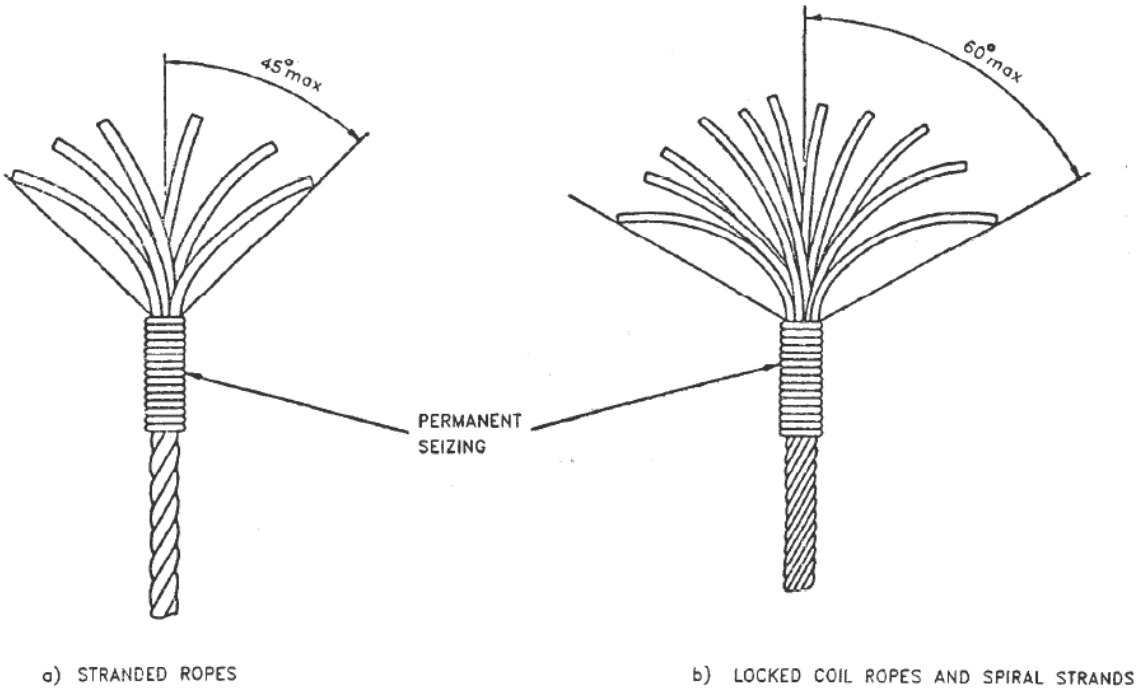


FIG. 1 OPENING ANGLE OF THE BRUSH

**7.2** Any entrapped air may be removed by stirring the resin with a single wire.

**7.3** Should the initial mix of resin be insufficient to fill the socket, or, in the case of large sockets should any shrinkage occur, it is important that the manufacturer's instructions regarding topping up procedures be followed carefully.

**7.4** After pouring, the resin must be allowed to harden before any attempt is made to move the rope or socket.

**7.5** The hardness of the material can be ascertained by checking any residual material in the mixing vessel or, simply, by scratching the surface of the resin in the socket with a piece of sharp metal.

**7.6** When the resin has hardened, the seizing should be removed up to the mouth of the socket to facilitate inspection.

**7.7** A suitable corrosion preventive compound should be applied to the cleaned length of the rope taking care to cover all exposed wires and to seal the mouth of the socket.

## 8 SOCKETING RESINS

**8.1** Manufacturer or sponsor instructions should always be consulted before use and care should be taken not to exceed the recommended shelf life of the material.

**8.2** Resin socketing offered for use shall have passed the prototype test on the socketed assembly, as specified in Annex A.

**8.3** The manufacturer should provide adequate information on the resin socketing system.

## 9 QUALITY CONTROL

The quality of the socketing may be assessed in one of the following ways :

a) By removing the cone after solidification, and visually inspecting it to ensure that it is satisfactory. If this method is used, care should be taken to ensure that the orientation of the cone in the socket is the same before and after inspection, this may be achieved by setting a mark.

b) By visual inspection to ensure that the socket resin has completely filled the annulus between the rope and the socket mouth, and that the socket is properly filled with socketing material.

c) By proof loading to 40 percent of the minimum specified breaking load of the rope, after which the rope shall not have moved out of the mouth of the socket by more than 2 percent of the basket length.

## ANNEX A

(*Normative*)

## Type Testing for Performance Assessment of Socketing System

### A-1 GENERAL

For each socketing system for which the socket is intended to be used, the socket system designer shall carryout tensile tests on socketed end terminations representing the most extreme and unfavorable combinations of rope construction, rope strength and socket basket dimensions.

NOTE — Too short a basket length could, at worst, result in insufficient embedded length of wire and pull-out of the rope from the socket.

### A-2 TEST METHOD

#### A-2.1 General

The test method shall be in accordance with **A.2.2**. The minimum free test length, excluding terminations, shall be in accordance with Table A.1.

**Table A.1 Test Lengths**

(Dimensions in millimetres)

| Sl No. | Nominal rope diameter | Minimum test length | |
|---|---|---|---|
| | *d* | Stranded rope | Locked Coil |
| (1) | (2) | (3) | (4) |
| i) | 6 to 20 | 600 | 1000 |
| ii) | 20 to 60 | 30*d* | 50*d* |

The selected test piece shall have its ends secured to ensure that the rope does not visibly unravel.

#### A-2.2 Test Method

The test piece in the machine shall be mounted and secured to ensure that all the wires in the rope are subjected to force during the test. If sockets or cones are used, the method of socketing shall be as specified in this standard.

After 80 % of the minimum breaking force, $F_{min}$, has been applied, the force shall be increased at a rate of not more than 0.5% of the minimum breaking force per second.

The measured breaking force value, $F_m$, shall be deemed to have been reached when no further increase in the applied force is possible and the rope is broken.

The test may be terminated without breaking the rope when the minimum breaking force, $F_{min}$, value is achieved or exceeded.

### A-3 ACCEPTANCE CRITERIA

The rope shall be deemed to have satisfied the breaking force required when the measured force, $F_m$, reaches or exceeds the guaranteed value.

If any of the tensile tests fail to meet the minimum breaking force, a further two socketed end terminations shall be tested. These tests shall use the same :

a) Rope size, construction and minimum breaking force,

b) Size, design and material of socket,

c) Socketing medium, and

d) Same method of socketing.

If these tests are satisfactory, the method of socketing and the socketing medium shall be deemed suitable for the socket and ropes under test.

If one or both the terminations fail the re-testing, the method of socketing and socketing media shall be deemed unsuitable for the socket and ropes under test.

## A-4 TEST REPORT

The test report shall include the following:

a) The test number;

b) A reference to the test method used;

c) The rope designation, minimum breaking force of the rope and socketing media for which the socket is suitable;

d) The test results.

## ANNEX B

*(Normative)*

## RESIN SOCKETING MEDIA

### B-1 GENERAL

Resin systems shall be polyester-based and shall include inorganic filler and a curing agent.

Inert fillers are permissible and in the case of polyesters, they are recommended.

### B-2 PHYSICAL PROPERTIES

Resin systems shall have the following physical properties :

a) When tested in accordance with IS 13360 (Part 5/Sec 8), the resin system (cube size 40 mm) shall have a minimum ultimate compressive strength of 90 $N/mm^2$;

b) When tested in accordance with IS 13360 (Part 5/Sec 8), the resin system shall have a minimum ultimate shear strength of 15 $N/mm^2$;

c) When tested in accordance with IS 13360 (Part 6/Sec 17), Method A, the resin system shall have a minimum heat distortion point of 110°C;

d) When tested in accordance with IS 13360 (Part 5/Sec 8), the resin system shall have a minimum modulus of elasticity of 6 000 $N/mm^2$;

e) The system shall have a minimum Barcol hardness of 36.

f) When tested in accordance with IS 1448 (Part 32), the resin system shall have a specific gravity of between a minimum of 1.54 and a maximum of 1.96.

## ANNEX C

*(Foreword)*

## COMMITTEE COMPOSITION

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Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the website-www.bis.gov.in or www.standardsbis.in.

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## Amendments Issued Since Publication

| Amend No. | Date of Issue | Text Affected |
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